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SOVIET BLOC INTERNATIONAL GEOPHYSICAL YEAR INFORMATION

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I. ROCKETS AND ARTIFICIAL EARTH SATELLITES

Popular-Science Films Being Developed in USSR

A 3-year plan providing for the production of more than 400 popular-science films has just been approved by the Ministry of Culture USSR. Among the films to be completed in the near future are "Explorers of the Universe," on Soviet rocket techniques; "Automatons in the Cosmos," on the use of rockets at high altitudes; "Television from Earth Satellites," on prospects for using satellites for long-distance television broadcasts; "Cosmic Medicine," on the study of the influence exercised by cosmic processes on living organisms; and "Four-Footed Astronauts," on the training of animals for flights in space [all titles translated from the French].

In addition to the films devoted to future interplanetary trips, about 20 films on the peaceful uses of atomic energy will be made. (Paris, L'Humanite, 30 Aug 58)

Preliminary Results of Sputnik II Cosmic Ray Measurements

A complete translation of the article, "The Measurement of Cosmic Radiation by an Artificial Earth Satellite," by S. N. Vernov corresponding member of the Academy of Sciences USSR, N. L. Grigorov, Yu. I. Logachev and A. Ye. Chudakov, follows:

"The preliminary results obtained by apparatus installed in Sputnik II are presented in the current article.

"Two similar instruments for the desired recording of variations of the intensity of cosmic radiation were installed in the satellite. Both instruments were completely independent, and thus the coincidence of their readings provided a check on the proper operation of the apparatus in flight.

"Each of the instruments consisted of a charged particle counter with an operating length of 100 millimeters and a diameter of 18 millimeters. The average amount of matter surrounding the counter was 10 gram/cm^2. The operating voltage of the counter (400 v) was provided with the aid of a semiconductor converter, which was fed from a battery with a voltage of 6 1/2 v.

"Both instruments contained scaler devices which were made of semi-conductor transistors and required a power of 0.1 watt each. A power reserve ensured the continuous operation of the instrument for 200 hours. The weight of the instrument and power supply was 2.5 kilograms. The elements of the instrument's system were previously described [Usp. Fiz. Nauk, Vol 63, No 1, 1957, p 149].

"During the flight of the satellite in its direct spiral over the territory of the Soviet Union (the motion from south to north), its flight altitude over the surface of the Earth remained practically unchanged (225-240 kilometers). During its motion in the reverse spiral, the altitude of the flight grew approximately from 350 up to 700 kilometers with the decrease in latitude from 65° N to 40° N latitude. The relation of the intensity of cosmic radiation of the reverse spiral in relation to the intensity in the direct spiral at one and the same geographic points gives the relative increase of intensity at the expense of the difference in altitude [see Figure 1 of original article]. If the relationship of cosmic ray intensity to altitude were one and the same at different altitudes, then Figure 1 would give this relationship.

"The change in intensity of cosmic rays in relationship to altitude beyond the limits of the atmosphere can be due to at least three effects: (1) the increase of intensity at the expense of the decrease in the screening action of the Earth; (2) the increase of intensity because the lessening of the Earth's magnetic field leads to a decrease in the generation of the energy of particles which can penetrate through the Earth's magnetic field; and (3) the change of the albedo of cosmic radiation. The discovered altitude relationship can be explained by the calculation of only two primary effects.

"The measurements conducted of cosmic ray intensity during the flight of the satellite at many direct spirals makes it possible to construct lines of equal intensity of this radiation (isocosms).

"In Figure 2, isocosms for three values of the velocity of light are presented: 18, 27 and 36 impulses per second.

"As can be seen from Figure 1, experimental points, best of all, lie on the geographic parallels. In the equatorial region, Simpson [J. A. Simpson, K. B. Fenton, J. Katzman and D. C. Rose, Phys. Rev., 102, 1648 (1956); and J. A. Simpson, Report on the Conference at Varenna] discovered that the lines of minimum cosmic ray intensity ("cosmic equator") did not coincide with the geomagnetic equator. In connection with this, the receipt of data concerning the distribution of cosmic ray intensities over the whole world is of great interest.

"The dispersion of the points in Figure 2 exceeds by two or three times that dispersion which could be expected from statistical errors alone. It is possible that this is connected with variations in the intensity of cosmic rays. Analysis of the obtained data shows that considerable increases in the intensity of cosmic rays are sometimes observed. Thus, on 7 November 1957, in the time interval from 0436 to 0449 (Moscow time), an increase in the intensity of cosmic radiation of approximately 50 percent was registered at latitudes above 58 degrees. This increase was registered by two instruments. The change in the intensity of cosmic rays during this 'flare', according to the data of both instruments is shown in Figure 3 (the graph curve represents the data of the instrument and the points, the data of the other instrument). In this same drawing, the points of the curve indicate variations in the intensity of cosmic radiation as a function of time which could be expected from averaged data obtained according to all spirals, excluding the spiral in which the 'flare' was observed.

"The most detailed data on intensity during this 'flare' is related to the smaller time intervals shown in Figure 4. Attention is drawn to the fact that during the 'flare', greater fluctuations of intensity, exceeding the statistical fluctuations many times, were observed." (Doklady Akademii Nauk SSSR, Vol 120, No 6, 1958, pp 1231-1233)

Relation of a Restricted Three-Body Problem With Satellite Orbits

The following is a complete translation of the article "Problem on the Relation of a Restricted Three-Body Problem to the Motion of Artificial Earth Satellites," by F. Yu. Zigel.

"In connection with the creation of artificial Earth satellites it is of interest to determine theoretically various orbits which their motion could follow.

"Because the masses of artificial earth satellites are negligibly small in comparison with the masses of the Earth and the Moon, their motion in the Earth-Moon system may be considered as the motion of a body with a negligibly small mass in a restricted three body problem. On the other hand, for a satellite of arbitrary mass, including a mass as small as desired, the particular three body problems analyzed by Lagrange are applicable.

"By designating the mass of the Earth with M, and the mass of the Moon with m and assuming $M/m = 81$, let us find the position of the libration points in the particular case of Lagrange for the Earth-Moon system.

"Formulas of first approximation giving the distances of collinear libration points L_1, L_2, L_3 from the center of the Earth are [M. F. Subbotin, Kurs nebesnoy mekhaniki (Course in Celestial Mechanics), Vol 2, 1937.]

$$r_1 = r_o \left[1 - \left(\frac{m}{3M}\right) 1/3\right],$$

$$r_2 = r_o \left[1 + \left(\frac{m}{3M + m}\right) 1/3\right],$$

$$r_3 = r_o \left[1 - \frac{7\ m}{12\ M + 26\ m}\right],$$

where r_o is the mean distance from the Earth's center to the Moon.

"Regarding the triangular libration points L_4 and L_5, as is known, they form, together with the Earth and the Moon, the vertices of two equilateral triangles.

"Computation using the above formulas gives the following results:

$$r_1 = 0.839752 \quad r_2 = 1.160029 \quad r_3 = 0.992986,$$

where r_1, r_2, r_3 are the distance of collinear libration points from the Earth's center in units of the mean distance Earth-Moon (Figure 1).

"The libration points in the special Lagrange case have the property that a body (satellite) located at any of these points with a zero relative velocity will remain there forever conserving a permanent configuration with respect to the other two bodies (Earth and Moon). We should keep in mind that the libration points will be motionless only in a rotating system of coordinates, the origin of which will coincide with the center of gravity of the Earth-Moon system and the abscissa axis will pass through the centers of both of these bodies.

"The collinear libration points are points of unstable equilibrium and therefore satellites located at these points will leave the equilibrium position at the least displacement and may move far away from the libration points. It is true that by means of reaction engines it will be possible to return the satellite to the initial position and in this way secure an "artificial stability." For astronavigational purposes, the points L_1 and L_2 which are relatively close to the Moon, are of interest. From them, it would be possible to study in detail its surface as well as the unseen side of the Moon.

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"A satellite located at either of the triangular libration points L_4 and L_5 may stay there a sufficiently long time, because the stability criterion according to the first approximation of the system Earth-Moon-triangular libration point is satisfied. The motion of satellites near the points L_4, L_5 will be similar to the motion of the Trojan group asteroids revolving around the Sun nearly on Jupiter's orbit.

Cosmic stations at the points L_4 and L_5 will be, in the full meaning of the term, interplanetary stations, equally distant from the Earth and the Moon. At the same time, the stability of their position in relation to Earth and Moon will facilitate regular communication of these stations with our planet and will permitthe accumulation there of considerable provisions of fuel for interplanetary flights. A low thrust for a flight to the planets, the possibility of constantly seeing nearly the whole sky -- these are only a few advantages of cosmic stations at points L_4 and L_5.

"Besides 'librating' satellites having an approximately constant position with respect to the Earth and Moon, other satellites, too, are conceivable, performing periodic motions in the above specified rotating system of coordinates.

"Periodic solutions of the restricted three body problem were studied by Jacoby, G. Darwin, Poincare, Tyle, E. Stromgren and others [H. Poincare, Les methodes nouvelles de la mecanique celeste (New Methods of Celestial Mechanics), Paris, 1892-1899; G. Darwin, Periodic Orbits, Acta Math., 21, 1897; E. Stromgren, Connaissance actuelle des orbites dans le probleme de trois corps. (Actual Knowledge of Orbits in the Three Body Problem), Publ.og mindre Med. fra Kobenhavns Obs., No 100, 1936]. The computation of closed (periodic) orbits of the third body (of small mass) in the three body problem may be carried out by the method of numerical integration.

"Among various classes of periodic orbits, the following classes draw our attention:

1. Periodic orbits around bodies with finite masses (in our case with masses M and m), which the third body (satellite) will follow in a direction opposite to the rotation of the mobile system of coordinates. Figure 2 shows some of the orbits of this class for the case when $M = m$. The orbits remote from the bodies with M and m masses approach circles in shape, but coming nearer the specified bodies, the orbits flatten and become similar to ellipses.

For astronavigational purposes the orbit of type three is of particular interest. A satellite revolving on such an orbit will be in constant communication with the Earth as well as with the Moon. From such a satellite, a detailed study of the lunar surface will be convenient and even a "landing" on the Moon will be possible.

2. Periodic orbits with retrograde motion around the libration points. Figure 3 shows, for the case $M = m$, two orbits of the specified class: one, surrounding only the point L_2; the second, with a loop around the Moon. It is possible that for some astronavigational purposes such orbits will also be of interest. Thus, for example, a satellite revolving in a loop-shaped orbit may have a constant communication with some lunar station and at the same time depart for into interplanetary space.

The examples presented show that the possible motions of artificial Earth satellites are far from being exhausted by revolutions on circular orbits. It would be very interesting to compute by means of numerical integration concrete periodic satellite orbits for the case $M = 81\ m$, specifying real initial conditions and evaluating thereafter the elements of the obtained orbits from the viewpoint of astronautics. (Byulleten' Vsesoyuznogo Astronomo-Geodezicheskogo Obshchestva, No 2 (28), 1958, pp 14-16)

Moon-Flight Article by Shternfel'd for Young Readers

An article, "Path to the Moon," by A. Shternfel'd, winner of an International Incentive Award for Astronautics, appears in the July issue of Vokrug Sveta, monthly geographic popular science magazine of the Central Committee of the All-Union Lenin's Young Communist League. (Vokrug Sveta, No 7, Jul 58, pp 1-8)

II. UPPER ATMOSPHERE

Radar Studies of Meteor Activity in Khar'kov

The results of investigations of "Meteor Activity by the Radar Method at a Frequency of 72 Megacycles" from June to September 1957, which were conducted in Khar'kov, are presented in an article by B. S. Dudnik, B. L. Kashcheyen, M. F. Lagunin, I. A. Lysenko, V. V. Tolstov, and I. A. Delov of the Khar'kov Polytechnic Institute.

A system of noise filtering was developed to make it possible to conduct observations during periods when interference was at a high level.

The number of sporadic meteors was found to have two daily maximums, one in the morning and one at night.

The level of meteor activity in June and July was considered to be high. The greatest activity during these months was noted at night. The average hourly number of recorded meteors reached as high as 21 (24 June). With the exception of 8 September, meteor activity in September was considerably lower than in July and August. (Izvestiya Vysshikh Uchevnykh Zavedeniy, Radiofizika, Vol 1, No 2, Mar-Apr 58, pp 66-70).

Ambartsumyan Awarded Order of Lenin

The Order of Lenin was awarded to Viktor Amazaspovich Ambartsumyan, president of the Academy of Sciences Armenian SSR, by the Presidium of the Supreme Soviet USSR on 17 September. The award, coinciding with Ambartsumyan's 50th birthday, was given for outstanding service in the field of astronomy. (Moscow, Pravda, 18 Sep 58)

Determination of Exact Coordinates of the Moon

I. V. Gavrilov, Main Astronomic Observatory of the Academy of Sciences Ukrainian SSR, presents the results of an analysis of 103 photographs of the Moon taken for studying its figure in connection with the presence of the libration effect in the radius. Explaining the libration effect by the presence of the so-called great relief, the author reveals the influence of this effect on the lunar coordinates. The computed values obtained explain well the origin of empirical corrections to the lunar coordinates.

The full text of the article, excluding figures 1 and 2 and tables 2 and 3, entitled "Some Results of an Investigation of the Moon's Figure for Determining Its Exact Coordinates," which appeared in the IGY Information Bulletin of the Academy of Sciences Ukrainian SSR, is presented here:

Among the great number of investigations according to the IGY program, investigations with the use of astronomical methods and observations are far from last place. Such investigations include, as is known, photographic observations of the Moon for determining its exact coordinates. The study of the orbital motion of the Moon, as well as other celestial bodies, makes it possible in many cases to solve certain problems of a geophysical character.

The motion of the Moon among the stars from the viewpoint of celestial mechanics is studied with sufficient accuracy. This makes it possible to compare the observed coordinates of the Moon with coordinates computed on the basis of gravitation theory and the differences between them are attributed to other, nongravitational, reasons. At present, it can be stated with certainty that among the latter there are even reasons of a geophysical character.

Not going beyond the limits of the theme of this article, we shall briefly enumerate those problems of a geophysical character for whose solution it is necessary to enlist the observations of the Moon:

1. Study of the nonuniformity of the Earth' rotation.

2. Determination of ephemeris (Newtonian) time.

3. Determination of the dimensions of the geoid and solution of problems of higher geodesy.

4. Study of the movement of the continents.

As is evident from the aforementioned, observations of the exact coordinates of the Moon are of tremendous importance in the study of the Earth as a whole planet.

The study of the orbital motion of the Moon, as well as the study of physical libration, always rests on the question concerning the figure of the Moon. The fact is that during observations measurements of the limb of the lunar disc, whose form changes relative to optical libration, are always being made. This change in the form of the limb of the lunar disc adduces to the fact that the center of the figure of the Moon, found from measurements of the limb, does not always coincide with the center of the lunar mass. Thus, a comparison of observation results with theory, without taking into account the relative position of the center of mass and the center of the figure of the Moon, is incorrect. This circumstance results especially from the relation of the radius of the Moon to libration in latitude, a fact which is confirmed by an entire series of heliometric observations and indirectly by other observations. The relation of the radius to libration in latitude β_0 , in the first approximation, is considered linear:

$$R = R_0 + b\beta_0 \qquad (1)$$

where R_0 is the radius when $\beta_0 = 0^\circ$; the term $b\beta_0$ expresses the libration effect in the radius.

A summary of determinations of the coefficient b is given in Table 1.

Table 1

Series of Observations

Observer	Years	No of Observations	Method of Observations	Value
Shlyuter [Schlueter]	1841-1843	158	Heliometric	-0".090
Gartvig [Hartwig]	1884-1885	36	"	-0.040
	1840-1915	235	"	-0.029
Banakhevich	1910-1915	130	"	-0.030
Yakovkin	1916-1931	250	"	-0.048
Bel'kovich	1932-1942	150	"	-0.035

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Series of Observations

Observer	Years	No of Observations	Method of Observations	Value
Nefed'yev	1938-1945	143	Heliometric	-0.041
Khabibullin	1949-1952	40	Photographic	-0.070
Drofa	1950-1953	32	Micrometric	-0.115

Evidently, the dispersion of values of the coefficient b speaks for the fact that, at present, it cannot be said that the libration effect is not known by us with sufficient accuracy. In addition, there is a basis to assume that it differs for the eastern and western limbs of the Moon. Thus, the study of the libration effect and its influence on the relative position of the center of the figure and the center of the mass of the Moon is an interesting and timely problem.

In the Main Astronomical Observatory of the Academy of Sciences Ukrainian SSR, investigations of the figure of the Moon are conducted under the supervision of A. A. Yakovkin on photographs taken by the 400-mm astrograph (D = 400, F = 5500 mm) with the aid of an automatically moving plate holder (Fig. 1).

In this article, certain results of processing of the first series of photographic observations 1955-1957 are presented. More than 100 negatives suitable for measurements were selected for analysis. Data on them are given in Table 2. Columns 4 and 5 of this table contain topocentric values of optical libration in longitude and latitude. Column 6 gives the radius of the Moon taken from Astronomicheskiy Yezhegodnik SSSR (Astronomical Yearbook of the USSR) and burdened by the parallax. Column 7 gives the characteristic of the photographic density of the negative. In Column 8 the measured limb of the Moon is indicated by Z (western) and V (eastern). The method of observations with use of the automatically moving plate holder was described by us in an earlier work [5].

In processing photographs of the Moon, the determination of the scale of the plates plays an important role. For this purpose, we especially investigated the relation of the scale of the plates to the temperature of the astrograph. This relation is presented graphically in Figure 2. The results obtained permit determining the scale of every plate according to the astrograph temperature during the time of observation and according to the focal scale reading. It should be noted that photography, as a rule, was done strictly by a focus with an accuracy to 0.1-0.2 mm. This was achieved thanks to the use of data from a special astrograph investigation [6].

For revealing the influence of photographic irradiation on the results, the relation of the Moon's radius to the density of the photographic image on the plate was investigated. The investigation results show that there is a slight influence of the density of the negative on the magnitude of the radius and it should be excluded [13]. This exclusion we make simultaneously with the determination of the libration coefficient, introducing an additional term in the conditional equations.

Plate measurements were made on the KIM-3 measuring machine by the Hayn method. Vector radii of limb points were measured from the technical origin of the coordinates (the mark close to the center of the Moon) through 6° on a positional circle. Thus, in each plate, measurements on 26-30 vector radii were made. The values of vector radii are free from the influence of differential refraction whereupon conditional equations of the following type were constructed:

$$x \cos Pi + Y \sin Pi - \Delta r_0 = R'_0 - r_i \qquad (2)$$

where x, y are coordinates of the mark, Pi is the positional angle of the limb point, Δr_0 is the correction to the ephemeridal radius resulting from the observations, R'_0 is the ephemeridal radius burdened by the parallax, r_i are the measured vector radii.

The number of equations corresponds to the number of measured vector radii. From equations (2) the values x, y and Δr_0 are found by the method of least squares. The average error in determining the Moon's radius by our plates is $\pm 0.''37$.

The solution of the system of equations (2) corresponds to the finding of the most likely circumference, which, by the best manner, coincides with the measured points of the Moon's limb. Corrections for the nonuniformity of the limb to avoid systematic errors were not introduced.

For investigating the libration effect, we selected and solved a 61 system with measurements on the western limb of the Moon and a 41 system with measurements on the Moon's eastern limb. In view of the fact that as a result of the solution of these systems of equations similar unknowns are obtained with weights of the same order and approximately identical accuracy, we assigned to them weight in relation to the quality of the negative (sharpness of the Moon's limb). For perfect negatives, a weight of 1.00 was used, for good - 0.75 for satisfactory - 0.50.

The values for $\Delta\ r_0$ given in Table 3 and obtained from the solutions of systems of equations (2), compared with libration in the following manner. The following relation was sought:

$$a + b\ \beta'_0 + c\ \lambda'_0 + dD = \Delta\ r^0 \qquad (3)$$

where β'_0 and λ'_0 represent topocentric optical libration in latitude and longitude, D is the density of the negative; the term dD is introduced for excluding the relation of the radius to the density of the negative.

The solution of equations (3) by the method of least squares, separately for the western and eastern limb, taking into account the weight, gave the following results

for the western limb

$$\Delta r_0 = -0''.077 + 0''.039\,\beta'_0 - 0''.039\,\lambda'_0 + 0''.45D \qquad (4)$$
$$\pm 99 \qquad \pm 19 \qquad \pm 20 \qquad \pm 20$$

for the eastern limb

$$\Delta r_0 = +0''.631 - 0''.000\,\beta'_0 + 0''.072\,\lambda'_0 + 0''.009D. \qquad (5)$$
$$\pm 229 \qquad \pm 50 \qquad \pm 62 \qquad \pm 8$$

Evidently, the relation of the Moon's radius to liberation, according to our observations, is revealed and it occurs in rather favorable agreement with the results obtained from other series.

Convinced that our series of photographic observations confirm the presence of the libration effect in the radius, we, by these same observations, checked a model of the figure of the Moon suggested by A. A. Yakovkin.

In the model mentioned, the presence in the region of the south pole of a plateau of variable thickness is assumed. In this connection of the limb of the lunar disc is described by a curve with two parameters:

$$R = R_0 + a\cos^2 P; \quad a = 0 \text{ with } 270^\circ \leq P \leq 90^\circ \qquad (6)$$

Thus, the northern part of the Moon's figure is a hemisphere with a radius R_0 and center coinciding with the center of the mass. The southern part of the figure is practically a semiellipsoid with semiaxes R_0 and $R_0 + a$. Interest raises the question as to what extent this model satisfies the observations. We did not find such a direct verification in the literature. It is known only from the works of A. A. Yakovkin that this model, according to indirect data, is probably not very far from the truth.

On the basis of measured vector radii of points of the limb systems of conditional equations of the following type were constructed:

$$X \cos Pi + Y \sin Pi - \Delta R_0 - a \cos^2 Pi = R'_0 - ri$$
$$a = 0 \text{ with } 270^\circ \leq Pi \leq 90^\circ \qquad (7)$$

where X and Y are coordinates of the work relative to the center of the most probable circumference which, in the best manner, coincides with the points of the limb of the northern part of the lunar disc, ΔR_0 is the correction to the ephemeridal radius giving the radius of the northern part of the disc, a is the thickness of the supplemental layer in the region of the south pole. From the solution of these syrtems X, Y, ΔR_0 and a were obtained.

The appearance of libration effects in the parameters ΔR_0 and a, given in columns 3 and 4 of Table 3, occurred simultaneously with the appearance of libration effects in the locality of the center of the figure relative to the center of the mass of the Moon. For this, the differences X - x and Y - y were constructed. These differences, constructed according to the results of solutions of the equation systems (2) and (7), are the coordinates of the center of the figure relative to the center of mass of the Moon which, according to the given model, coincides with the center of the northern hemisphere.

For determining coefficients of libration effects systems of conditional equations of the type in (3), whose right side consisted of the values ΔR_0, a, X-x, Y-y, were constructed. The solution of these equation systems by the method of least squares gave the following results:

for the western limb

$$\Delta R_0 = -0''.946 - 0''.094\beta'_0 + 0''.004\lambda_0 + 0''.054D \qquad (8)$$
$$\pm 172 \qquad \pm 32 \qquad \pm 35 \qquad \pm 34$$

$$a = +1''.640 + 0''.245\beta'_0 - 0''.059\lambda_0 - 0''.023D; \qquad (9)$$
$$\pm 281 \qquad \pm 53 \qquad \pm 58 \qquad \pm 56$$

$$\begin{array}{lllll} X-x = & -0''.682 & -0''.100\,\beta'_0 & +0''.023\,\lambda'_0 & +0''.010D; \\ & \pm 112 & \pm 23 & \pm 21 & \pm 22 \end{array} \tag{10}$$

$$\begin{array}{lllll} Y-y = & +0''.750 & +0''.121\,\beta'_0 & -0''.031\,\lambda'_0 & +0''.002D; \\ & \pm 152 & \pm 29 & \pm 31 & \pm 30 \end{array} \tag{11}$$

for the eastern limb

$$\begin{array}{lllll} \Delta R_0 = & -0''.001 & -0''.330\,\beta'_0 & +0''.040\,\lambda'_0 & +0''.015D; \\ & \pm 248 & \pm 54 & \pm 67 & \pm 9 \end{array} \tag{12}$$

$$\begin{array}{lllll} a = & +0''.877 & +0''.678\,\beta'_0 & +0''.106\,\lambda'_0 & +0''.004D; \\ & \pm 562 & \pm 122 & \pm 151 & \pm 20 \end{array} \tag{13}$$

$$\begin{array}{lllll} X-x = & -0''.296 & -0''.275\,\beta'_0 & +0''.019\,\lambda'_0 & -0''.001D; \\ & \pm 163 & \pm 35 & \pm 44 & \pm 6 \end{array} \tag{14}$$

$$\begin{array}{lllll} Y-y = & -0''.645 & -0''.284\,\beta'_0 & -0''.028\,\lambda'_0 & +0''.008D. \\ & \pm 176 & \pm 38 & \pm 47 & \pm 6 \end{array} \tag{15}$$

An analysis of the relations (8) (15) makes it possible to conclude that the libration effect in the Moon's radius is actually the result of the presence in the region of the lunar south pole of the so-called great relief.

Relying only on the results obtained in the work cited, it is impossible to make more detailed conclusions on the details of this relief.

Because the values ΔR_0 and a are separated rather poorly, a model of the figure of the Moon can be constructed only in general outline. It is fully evident that in the light of the results obtained by us, the model proposed by A. A. Yakovkin satisfies the observations rather well and requires only detailing and a more precise determination of parameters. In the future, it is planned to use the results of a hypsometric study of the Moon's figure based on observations of the terminator.

The basic conclusion from the results of the work cited concerns the displacement of the center of the Moon's figure relative to the center of its mass. Actually, the relations (10), (11), and (14), (15) directly indicate how much the center of the Moon's figure is displaced for one and the other coordinate due to the presence of the great relief.

It can be considered fully proven that the existence of a constant correction of the latitude of the Moon, $0''.50$ on the average, is accounted for only in the presence of the aforementioned relief. The difference obtained by Markowitz [14] of longitude of the Moon, inferred for the western and eastern limb, also has its explanation in the presence of the great relief. These conclusions made previously by Yakovkin from indirect data are directly confirmed by our observations.

The results obtained by us will make it possible in determining the coordinates of the Moon from limb measurements to allow to a certain extent for the relative position of the center of the figure and the center of mass of the Moon. They will also serve as material for further specifying the figure of the Moon and constructing an average chart of the limb zone.

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Maksutov on Instruments at Pulkovo

D. D. Maksutov, Corresponding Member of the Academy of Sciences USSR and chief of the Division of Astronomical Instrument Building at Pulkovo, describes some of the instruments and the work on their development at the Main Astronomical Observatory, Academy of Sciences USSR, in an article entitled "Pulkovo Today, for New Discoveries."

Large telescopes and a variety of auxiliary apparatus are necessary for modern astronomical investigations and deeper penetrations into the secrets of the universe. The larger the telescope, says Maksutov, the greater the possibility for new discoveries. At present the Division of Astronomical Instrument Building at Pulkovo is working on the largest telescope in the world. Its mirror has a diameter of 6 meters. This is more than that of the famous Palomar telescope in the US, which has a diameter of 5 meters. For the production and investigation of the mirrors of large telescopes a compensation method" was developed by Maksutov. This method provides for a great economical effect, a reduction of costs and of production time.

In creating new telescopes, the workers of the division devote much attention to the perfection of the most important detail, the main mirror.

"Since 1941," says Maksutov, "I worked over the meniscus systems. The meniscus is a lens which is located in the converging cluster of rays not far from the focus. Because of this it was possible to reduce the measurements of the lens and the telescope."

A number of such instruments are already in use at Pulkovo, Abastumani, and other observatories. Expeditionary telescopes (AZT-7) which are found in the expeditions of the Pulkovo observatory operating in the USSR for investigating the astroclimate with the aim of selecting the place for the installation of the future great telescope are also equipped with meniscus lenses. These portable telescopes have small dimensions together with great power. A meniscus expeditionary telescope with a mirror diameter of 140 millimeters and an over-all length of only 25 centimeters was built recently by the shops of the Pulkovo observatory.

Maksutov reveals that the Russkiye Samotsvety Plant has begun issuing meniscus school telescopes with his system and also long-distance telephoto meniscus systems for mirror cameras.

At present the observatories are being used for the perfection of these systems. In addition to this, they are working on the development of a camera for artificial earth satellite observations which uses the meniscus system. The manufacture of a whole series of such cameras is planned. According to calculations these will have a 1:1.4x lens, an opening of 0.5 meter, and a mirror diameter of 1.25 meters.

Another facet of the work at Pulkovo is connected with the use of metallic mirrors in telescopes. Glass is the most suitable material for optical mirrors, but, since it is a poor conductor of heat, changes in the shape of the mirror surface arise with heating. The larger the mirror and the temperature gradient, the greater the distortion. The quality of metallic mirrors in this respect is incomparably higher.

Investigations on the use of automatic star followers for telescopes are being conducted by a group of workers at the observatory under N. N. Mikhel'son. This is achieved with the aid of electronic computers controlling the motion of the telescope. (Nauka i Zhizn', No 6, Jun 58, pp 15-16)

III. METEOROLOGY

Soviet Study on Scatter of Reflected Light in a Homogeneous Atmosphere

The article "The Effect of Horizontal Changes in the Albedo of an Underlying Surface on the Scattering of Light in a Homogeneous Atmosphere," by M. S. Malenkevich, Institute of Physics of the Atmosphere, Academy of Sciences USSR, recently, appeared in a late issue of a Soviet scientific periodical.

A method of calculating inhomogeneities of an underlying surface in the theory of the scattering of light in cloudy media, previously proposed by the author ["Calculation of the Inhomogeneities of an Underlying Surface in the Problem of the Scattering of Light in the Atmosphere," Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 5, 1957] is applied to the case of homogeneous isotropically scattering atmosphere. The intensities and flows of radiation at all levels and the changes of the function of the source and total albedo with altitude over different parts of the underlying surface are calculated for an albedo periodically changing along one of the horizontal coordinates. (Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, No 8, Aug 58, pp 995-1005)

IV. GLACIOLOGY

Report on Fedchenko Glacier Expedition of 1957

A report on the "Expedition of the Geographic Faculty [of Leningrad State University] on the Fedchenko Glacier in the Summer of 1957" by Prof O. A. Drozdov, head of the expedition, appeared recently in a Soviet scientific periodical.

The Fedchenko Glacier is the object of allround investigations during the IGY. Among the various groups conducting these investigations was the independent expedition of the Geographic Faculty of Leningrad State University, composed of 18 men under Professor Drozdov.

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The expedition undertook to organize meteorological observations at the tongue, in the central part of the glacier, and in the firn zone, and to take part in microclimatic observations in the investigation of the tributaries of the glacier and in hydrological and geomorphological investigations at the glacier's tongue and on the glacier itself.

Drilling conducted at the 4,880-meter level (altitude) by Agashkin, a worker of the Institute of Geography, Academy of Sciences USSR, produced some very interesting results. At a depth of one meter the firn was moist and its temperature raised to 0 degrees. These temperatures showed little change down to 10 meters.

Winds on the upper part of the glacier were found to be rather strong and constantly driving down the snowdrifts. The direction of the wind is almost entirely from the south, that is, down the glacier. The strongest winds are observed in the morning after sunrise but before the sunlight reaches the glacier.

A system of valleys and depression which are favorable for the passage of winds from Central Asia cause the almost constant presence of unusual lenticular-type clouds over the Tanymas River valley.

Another reason for westerly winds in this region is the enormous area of ice formation in the region of Fedchenko Glacier and the practically bare plateau of Eastern Pamir.

The expedition compiled an album of high-mountain clouds according to data obtained in the Eastern Pamir and the upper part of the Fedchenko Glacier. Hydrological observations on the water discharge of the glacier were conducted.

A comparison of a survey of 1933 with the 1957 survey made by the expedition made it possible to determine the glacier's recession for these years. For this period the glacier receded 280-300 meters, during which the recession, judging from the moraine, was uniform.

Materials obtained by the expedition are now being processed. (Vestnik Leningradskogo Universiteta, No 12, Seriya Geologii i Geografii, No 2, 1958, pp 186-190)

V. ARCTIC AND ANTARCTIC

Antarctic Ice Reconnaissance

Soviet polar pilots conduct regular aerial ice reconnaissance in the Antarctic. Observations on ice conditions in the sea during the winter are of great interest to scientists. On 30 July, an extensive ice reconnaissance flight was made with an Il-12 plane, piloted by V. M. Perov, commander of the aerial detachment of the expedition, with the participation of Prof V. A. Bugayev, chief of the aerial detachment, and the hydrologists M. Izvekov and V. Lebedev. The plane set its course for an ice island, or iceberg, located north of the Shackleton Shelf Ice, from where the plane went to the north up to the edge of the ice. The weather during the flight was not very favorable. Low cloud formations forced the plane down to the ice. The plane flew at an altitude of 200 meters, occasionally rising to 1,200 meters.

Professor Bugayev conducted scientific observations of the air temperature and humidity and the wind speed and direction. Fields of broken ice with numerous icebergs stretched out below. Seals and penguins were seen on the floating ice floes. The ice fields soon came to an end, and, at a point with coordinates 60 37 S and 95 35 E, the water of the Indian Ocean was free of ice. From here the plane took its course toward Drygalski Island and, after inspecting the island and exploring the eastern part of the fast ice of Davis Sea, the plane returned to Mirnyy.

On 1 August, the pilots made a flight over the western part of Davis Sea, during which the hydrologists obtained valuable information on the distribution of ice in that area. (Moscow, Sovetskiy Flot, 13 Aug 58)

Fourth Antarctic Expedition in Preparation

The Special Committee for Antarctic Research recently passed a decision to organize new scientific stations on the coast and in the interior of Antarctica. Preparations are now in progress for the Fourth Soviet Antarctic Expedition.

At the same time, last-minute preparations are being made at the station Sovetskaya for a very important oversnow traverse, i.e., to the pole of relative inaccessibility. The distance from Sovetskaya to this point is 700 kilometers, and the route passes over mountain ridges rising more than 4,000 meters above sea level, across icy ravines and snow barriers. At the completion of this traverse, a new Soviet station, Polyus Nedostupnosti (Pole of Inaccessibility), will be established. The organization of this station will complete the main part of the program of the Third Soviet Antarctic Expedition. At the same time, it will represent an important stage in the solution of problems which will face the fourth expedition.

Recently the Arctic and Antarctic Institute in Leningrad, together with expedition leaders, examined the plan of the new Antarctic expedition. In October the Lena, first ship of the fourth expedition, will leave from the Kaliningrad port. This ship has made the voyage to the Antarctic several times. During previous trips, the Lena delivered its passengers and cargo to Mirnyy, the principal Soviet base. The route of the Lena on its forthcoming voyage will be changed, and the ship will dock at the coast of Queen Maud Land. This will be the point of disembarkation for the first staff members of a new Soviet station, to be named after the famous Russian navigator, Mikhail Lazarev. After landing a group of geologists at the station Lazarev, the Lena will sail along the coast of Antarctica to conduct oceanological research.

The Ob' will take a different route. It will transport passengers and cargo to Mirnyy and will then sail to the western part of the continent. Another Soviet scientific station will be opened there, on the coast of Bellingshausen Sea.

A third ship, the Feliks Dzerzhinskiy, will take part in the Fourth Antarctic Expedition. This large, new Soviet ship, which is equipped for navigating in the ice, will carry members of the continental expedition, headed by A. G. Dralkin, Candidate of Geographical Sciences. Dralkin has worked for 20 years in northern latitudes and has participated twice in the work of the drift station Severnyy Polyus-4.

The new continental expedition has a difficult task to perform. For the first time in the history of Antarctic exploration, almost 6,000 kilometers of ice plateau will have to be crossed. The Soviet explorers plan to complete this traverse in 4 months. The starting point of the expedition will be the station Vostok. All the necessary equipment will be delivered to this point ahead of time. From Vostok, the members of the expedition will head toward the south geographic pole. From there, via the pole of relative inaccessibility, the party will head for the coast of Queen Maud Land, where they will meet with the members of the new Soviet station Lazarev.

The continental expedition will consist of four truck-tractors. A Pingvin oversnow vehicle, which has easy maneuverability and has already proved itself in the Antarctic, will travel at the head of the column. This will be used as a "reconnaissance vehicle."

Most of the equipment and the expedition members will be transported by three truck-tractors, specially built for this expedition. So far these caterpillar vehicles have no official name, but they have already been nicknamed "Bogatyri." They are not only scientific laboratories, but comfortable field living quarters, each one having a bedroom, workroom, and kitchen. (Moscow, Pravda, 14 Sep 58)

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Plans for New Soviet Antarctic Expedition and Stations

During their scientific expedition across the Antarctic continent in 1958-1959, Soviet explorers will pass three poles, the south geomagnetic pole, pole of relative inaccessibility, and south geographic pole. The continental expedition will begin at the end of 1958, from Mirnyy, and will be concluded, after a temporary layover, during the summer season of 1959 on the coast of Queen Maud Land, in the area of the new station Lazarev. This station will be established at about the 10th degree of eastern longitude, between the Norwegian and Belgian antarctic bases.

The USSR Antarctic Expedition will organize other new stations on the coast of Bellingshausen Sea and at the "pole of relative inaccessibility." The existing station Sovetskaya will remain at its present location. Aerial reconnaissance has shown that the expeditionary party, which will travel to the pole of relative inaccessibility, will have to cross the highest regions of the continent. The station at this pole will be situated 700 kilometers nearer to the south geographic pole than Sovetskaya.

Instead of the originally planned transantarctic traverse, the new interior expedition is to be carried out in the form of a huge triangle, the sharp angle of which will be located at the south geographic pole.

In connection with the wishes expressed by representatives of the Polish Academy of Sciences concerning their participation in antarctic explorations with Soviet polar scientists, the details of such cooperation with the Polish colleagues are now being discussed.

As in previous years, the expeditions of the Soviet Union and of the US will have an exchange of scientists. (Moscow, Izvestiya, 14 Sep 58)

New Interdepartmental Antarctic Commission Formed

The Presidium of the Academy of Sciences USSR has formed an Interdepartmental Antarctic Commission in Moscow (Mezhduvedomstvennuyu Antarkticheskuyu Komissiyu) which will act in international organizations in the capacity of a Soviet National Antarctic Committee. (Moscow, Izvestiya, 14 Sep 58)

Report From Station Komsomol'skaya

The polar night in Antarctica came to an end in mid-August. The temperature is rising slowly; at present it rarely drops to minus 70 degrees centigrade, and is usually about minus 60 degrees centigrade.

On 10 September, after a 6-month interval, the first plane piloted by Perov, commander of the aerial detachment, arrived at Komsomol'skaya from Mirnyy. The plane dropped cargo and, after circling the station, returned to Mirnyy. The cargo included scientific instruments, as well as fresh vegetables, and even fresh fish caught with fishing rods near Mirnyy. (Moscow, Izvestiya, 16 Sep 58)

Scientists to Continue Work in Antarctic After IGY

In view of the great importance of scientific research in the Antarctic, scientists of many countries have decided to continue the study of Antarctica after the conclusion of the IGY. A Special Committee for Antarctic Research was formed to coordinate the activities of scientists. This committee has worked out a plan for the further study of Antarctica.

At the Moscow conference of the committee, it was recommended to the interested countries that new scientific stations be established in the coastal region of West Antarctica, between Ross Sea and Graham Land, on Wilkes Land, and Queen Maud Land, as well as a number of interior stations and island stations.

In accordance with these suggestions, the plan of the Fourth Soviet Antarctic Expedition was prepared, which is to be carried out by the Arctic and Antarctic Institute in cooperation with other scientific institutions of the USSR. A. G. Dralkin, Candidate of Geographical Sciences, a well-known polar explorer, will be the chief of the new expedition.

Soviet scientists intend to reach a final solution to the question of whether Antarctica is actually a continent or an archipelago of islands buried under the cover of ice. For this purpose, measurements of the ice cover between the station Vostok and the south geographic pole are to begin during 1958.

In October-November 1958, the station Sovetskaya is to be moved to the location of the pole of relative inaccessibility, i.e., about 700 kilometers to the southwest.

Two new Soviet scientific stations are to be established in places recommended by the Special Committee for Antarctic Research: one on Queen Maud Land in East Antarctica, and the other on the coast of Bellingshausen Sea in East Antarctica. These new stations will be named after the Russian navigators, Bellingshausen and Lazarev.

All other Soviet antarctic continental stations, except Pionerskaya, which will be closed in January, will continue to operate. (Moscow, Sovetskiy Flot, 28 Aug 58)

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